

CLAIMS

What is claimed is:

1. A method to enhance a digital image quality wherein original brightness data X_{ij} of a concerned pixel is compared with predetermined brightness levels X_1 and X_2 , which are reference variables to obtain new brightness data Y_{ij} , with an enhanced contrast, the method comprising:

setting initial values of a parameter V_b to calculate the brightness level X_1 , a parameter V_p to calculate the brightness level X_2 , the brightness level X_1 , and the brightness level X_2 ;

comparing the brightness data X_{ij} with the parameters V_b and V_p , respectively, and outputting results indicative thereof;

resetting the parameters V_b and V_p according to the results of the comparison;

identifying a background area according to the results of the comparison between the brightness data X_{ij} and parameter X_1 or X_2 ;

performing the contrast enhancement on pixels belonging to the background area; and

updating the brightness levels X_1 and X_2 using the parameters V_b and V_p , respectively, when the concerned pixel is the last one in the concerned line,

wherein the comparison of the brightness data X_{ij} with the parameters V_b and V_p is performed until one of the concerned pixel is the last one and the concerned pixel is the last pixel to be subject to the contrast enhancement.

2. The method of claim 1, wherein the comparison of the brightness data X_{ij} with the parameters V_b and V_p comprises:

determining whether the brightness data X_{ij} of the concerned pixel is less than the parameter V_b ;

subtracting a predetermined constant $\Delta 1$ from the parameter V_b and resetting a value of V_b when the brightness data X_{ij} is less than the parameter V_b ;

determining whether the brightness data X_{ij} of the concerned pixel is greater than the parameter V_p ; and

adding the predetermined constant $\Delta 1$ to the parameter V_p and resetting a value of V_p when the brightness data X_{ij} of the concerned pixel is greater than the parameter V_p .

3. The method of claim 1, wherein the identifying of the background area comprises:

determining whether the brightness data X_{ij} is less than or equal to the brightness level X_1 ;

performing a contrast enhancement of the dark background area by mapping the brightness level X_1 and the brightness data X_{ij} onto a predetermined value Y_1 and the new brightness data Y_{ij} , which is less than or equal to the predetermined value Y_1 , respectively when the brightness data X_{ij} is less than or equal to the brightness level X_1 ;

determining whether the brightness data X_{ij} is greater than or equal to the brightness level X_2 when the brightness data X_{ij} is greater than the brightness level X_1 ; and

performing the contrast enhancement of the light background area by mapping the brightness level X_2 and the brightness data X_{ij} onto a predetermined value Y_2 and the new brightness data Y_{ij} , which is greater than or equal to the predetermined value Y_2 when the brightness data X_{ij} is greater than or equal to the brightness level X_2 .

4. The method of claim 3, wherein the new brightness data Y_{ij} , which is less than or equal to the predetermined value Y_1 , with the enhanced contrast is obtained using the following equation:

$$Y_{ij} = \frac{Y_1}{X_1} X_{ij} .$$

5. The method of claim 3, wherein the new brightness data Y_{ij} , which is greater than or equal to the predetermined value Y_2 , with the enhanced contrast is obtained using the following equation:

$$Y_{ij} = \frac{255 - Y_2}{255 - X_2} (X_{ij} - X_2) + Y_2 .$$

6. The method of claim 3, further comprising:

performing the contrast enhancement for an area other than the background area by mapping the brightness data X_{ij} onto the new brightness data Y_{ij} , which is greater than Y_1 but less than Y_2 , when the brightness data X_{ij} is less than the brightness level X_2 .

7. The method of claim 6, wherein the new brightness data Y_{ij} with enhanced contrast is obtained using the following equation:

$$Y_{ij} = \frac{Y_2 - Y_1}{X_2 - X_1} (X_{ij} - X_1) + Y_1 .$$

8. The method of claim 1, wherein the updating of the brightness levels X1 and X2 comprises:

updating the brightness level X1 with a value derived by a first product of multiplying a predetermined weighting factor α by the parameter V_b and adding a predetermined offset to the first product; and

updating the brightness level X2 with a value derived by a second product of multiplying a predetermined weighting factor β by the parameter V_p and adding a predetermined offset b to the second product.

9. The method of claim 8, wherein the weighting factor α is determined in a range between 0 and 1, 0 exclusive ($0 < \alpha \leq 1$).

10. The method of claim 8, wherein the offset a is determined in a range between -128 and 127, inclusive ($-128 \leq a \leq 127$).

11. The method of claim 8, wherein the weighting factor β is determined in a range between 0 and 1, 0 exclusive ($0 < \beta \leq 1$).

12. The method of claim 8, wherein the offset b is determined in a range between -128 and 127, inclusive ($-128 \leq b \leq 127$).

13. The method of claim 1, further comprising:
compensating the parameters V_b and V_p .

14. The method of claim 13, wherein the compensation of the parameters V_b and V_p comprises:

updating V_b and V_p after adding and subtracting a predetermined constant $\Delta 2$ to and from the parameters V_b and V_p , respectively; and

updating V_b with the initial value of V_b if V_b compensated by the addition is greater than the initial value of V_b , and

updating V_p with the initial value of V_p if V_p compensated by the subtraction is less than the initial value of V_p set.

15. A digital image quality enhancing apparatus having a division unit dividing a concerned pixel with an input brightness data X_{ij} , in image data comprised of pixels having predetermined resolutions obtained by scanning a document, into a background area and an area other than the background area, and an enhancement unit performing contrast enhancement on the concerned pixel, wherein the division unit comprises:

a mediator signal detecting portion detecting a minimum value of the brightness data X_{ij} from a corresponding concerned line and outputting a mediator signal V_b while detecting a maximum value of the brightness data X_{ij} from the corresponding concerned line and outputting a mediator signal V_p ;

a reference signal generating portion outputting a signal X_1 derived by applying a predetermined weighting factor α and a predetermined offset a to the mediator signal V_b , in response to the mediator signal V_b , while outputting a signal X_2 derived by applying a predetermined weighting factor β and a predetermined offset b to the mediator signal V_p in response to the mediator signal V_p ; and

an area segmenting portion comparing the brightness data X_{ij} with the signals X_1 and X_2 and outputting a first background area signal if the brightness data X_{ij} is less than or equal to X_1 and a second background area signal if the brightness data X_{ij} is greater than or equal to X_2 .

16. The apparatus of claim 15, wherein the enhancement means comprises:

an enhancing portion of a dark background area outputting Y_{ij} obtained by decreasing a magnitude of the brightness data X_{ij} in response to the first background area signal and the signal X_1 using the signal X_1 and a predetermined value Y_1 corresponding to the signal X_1 ; and

an enhancing portion of a light background area outputting Y_{ij} obtained by increasing the magnitude of the brightness data X_{ij} using the signal X_2 and a predetermined value Y_2 corresponding to the signal X_2 in response to the second background area signal and signal X_2 .

17. The apparatus of claim 16, wherein the enhancing portion for the dark background area outputs the signal Y_{ij} , which is brightness data with enhanced contrast, obtained by the following Equation:

$$Y_{ij} = \frac{Y_1}{X_1} X_{ij}.$$

18. The apparatus of claim 16, wherein the enhancing portion for the light background area outputs the signal Y_{ij} , which is brightness data with the enhanced contrast, obtained by the following equation:

$$Y_{ij} = \frac{255 - Y_2}{255 - X_2} (X_{ij} - X_2) + Y_2.$$

19. The apparatus of claim 16, wherein the enhancement unit further comprises:
an enhancing portion of an area other than the background area that outputs Y_{ij} obtained by enhancing the brightness data X_{ij} in response to the area other than the background area and the signals X_1 and X_2 using the signals X_1 and X_2 and values Y_1 and Y_2 ,
wherein the area other than the background area signal is output by the area segmenting portion if the brightness data X_{ij} is greater than X_1 but less than X_2 .

20. The apparatus of claim 19, wherein the enhancing portion of an area other than the background area outputs brightness data Y_{ij} with the enhanced contrast using the following equation:

$$Y_{ij} = \frac{Y_2 - Y_1}{X_2 - X_1} (X_{ij} - X_1) + Y_1.$$